

Journal of Catalysis

EDITORS:

W. Keith Hall

Frank S. Stone

ASSOCIATE EDITOR:

Robert L. Burwell, Jr.

EDITORIAL BOARD:

R. B. Anderson

M. Boudart

J. B. Butt

A. Cimino

R. P. Eischens

P. C. Gravelle

J. W. Hightower

G. W. Keulks

H. Knözinger

M. Kraus

J. H. Lunsford

A. Nielsen

J. F. Roth

W. M. H. Sachtler

J. J. F. Scholten

K. Tamaru

S. J. Thomson

P. B. Weisz

P. B. Wells

J. T. Yates

Volume 89 • 1984



ACADEMIC PRESS, INC.

(Harcourt Brace Jovanovich, Publishers)

San Diego Orlando New York London

Toronto Montreal Sydney Tokyo

Copyright © 1984 by Academic Press, Inc.

All Rights Reserved

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owner.

The appearance of the code at the bottom of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated, per copy fee through the Copyright Clearance Center, Inc. (21 Congress Street, Salem, Massachusetts 01970), for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for creating new collective works, or for resale. Copy fees for pre-1984 articles are as shown on the article title pages; if no fee code appears on the title page, the copy fee is the same as for current articles.

0021-9517/84 \$3.00

MADE IN THE UNITED STATES OF AMERICA

Contents of Volume 89

Number 1, September 1984

F. LENORMAND, P. GIRARD, L. HILAIRE, M. F. RAVET, G. KRILL, AND G. MAIRE. Skeletal Rearrangement of Hydrocarbons on the Rare Earth Mixed Valence Intermetallic Compound CePd ₃	1
A. SÁRKÁNY. CH _x Addition-Abstraction Mechanism of Aromatization of Methylpentanes on Nickel and Cobalt Catalysts	14
STEVEN L. SUIB, KERRY C. MCMAHON, LI MIN TAU, AND CARROLL O. BENNETT. Synthesis, Characterization, and Fischer-Tropsch Studies of Iron-Containing Zeolites	20
J. W. A. SACHTLER AND G. A. SOMORJAI. Cyclohexane Dehydrogenation Catalyzed by Bimetallic Au-Pt(111) Single-Crystal Surfaces	35
G. CENTI, G. FORNASARI, AND F. TRIFIRÒ. On the Mechanism of <i>n</i> -Butane Oxidation to Maleic Anhydride: Oxidation in Oxygen-Stoichiometry-Controlled Conditions	44
C. R. APESTEGUIA, C. E. BREMA, T. F. GARETTO, A. BORGNA, AND J. M. PARERA. Sulfurization of Pt/Al ₂ O ₃ -Cl Catalysts. VI. Sulfur-Platinum Interaction Studied by Infrared Spectroscopy	52
FRANÇOIS FAJULA, RAFAEL IBARRA, FRANÇOIS FIGUERAS, AND CLAUDE GUEGUEN. Hydration of <i>n</i> -Butenes Using Zeolite Catalysts. Influence of the Aluminium Content on Activity	60
J. L. LEMBERTON, G. PEROT, AND M. GUISNET. Catalytic Isomerization of Ethylenic Hydrocarbons. XVIII. Effect of Drying and Reaction Temperature on the Isomerization of Deuterated Butenes over Magnesium Oxide	69
H. P. WANG AND JOHN T. YATES, JR. Spectroscopic Study of the Interconversion of Chemisorbed Surface Species: The Reaction Rh ^I (CO) ₂ + CO → Rh ^I (CO) ₃	79
J. P. CANDY AND V. PERRICHON. Magnetic Study of CO and C ₂ Hydrocarbons Adsorption on Pd/SiO ₂ Catalyst	93
M. WOLF, J. LIETO, B. A. MATRANA, D. B. ARNOLD, B. C. GATES, AND H. KNÖZINGER. Supported Dichlorotriosmium Clusters: Catalysts for Olefin Isomerization	100
J. L. G. FIERRO, L. GONZALEZ TEJUCA, A. LOPEZ AGUDO, AND S. W. WELLER. Studies of Molybdenum Sulfide Catalysts. I. Oxygen Chemisorption on Unsupported and Supported MoS ₂	111
GERALD L. VOGLER, XUAN-ZHEN JIANG, J. A. DUMESIC, AND R. J. MADON. The Use of Nitrous Oxide as a Surface Probe of Iron Catalysts for Fischer-Tropsch Synthesis	116
F. P. DALY. Methanol Synthesis over a Cu/ThO ₂ Catalyst	131
J. W. NIEMANTSVERDRIET, A. M. VAN DER KRAAN, AND W. N. DELGASS. Characterization of Surface Phases in Bimetallic FeRh/SiO ₂ Catalysts by <i>in Situ</i> Mössbauer Spectroscopy at Cryogenic Temperatures	138
ANDREW ISON AND RAYMOND J. GORTE. The Adsorption of Methanol and Water on H-ZSM-5	150

NOTES

A. A. DOST, V. R. DHANAK, AND S. BUCKINGHAM. XPS Study of β-Carbon Hydrogenation on Nickel(111) Surface	159
I. MANNINGER. The Kinetics of Pt-Black Catalyst Sintering in Different Atmospheres	164

ISAO KOJIMA AND EIZO MIYAZAKI. Catalysis by Transition Metal Carbides. V. Kinetic Measurements of Hydrogenation of CO over TaC, TiC, and Mo ₂ C Catalysts	168
B. L. YANG, M. C. KUNG, AND H. H. KUNG. Reasons for the Different Selectivities in the Selective Oxidation of Butene on α - and γ -Fe ₂ O ₃	172
TEIJI CHIHARA. Attractive Interactions of Alkyl Substituents with Palladium Catalyst in the Hydrogenation of Cyclohexanones	177
KAREL K. CZANDERNA, KAREN J. MORRISSEY, C. B. CARTER, AND ROBERT P. MERRILL. High-Resolution TEM Observations of γ -Al ₂ O ₃ in Transition Alumina Films	182

Number 2, October 1984

J. G. HIGHFIELD AND J. B. MOFFAT. Characterization of 12-Tungstophosphoric Acid and Related Salts Using Photoacoustic Spectroscopy in the Infrared Region. II. Interactions with Pyridine	185
MASAMICHI AKIMOTO, HITOSHI IKEDA, AKIRA OKABE, AND ETSURO ECHIGOYA. 12-Heteropolymolybdates as Catalysts for Vapor-Phase Oxidative Dehydrogenation of Isobutyric Acid. 3. Molybdotungstophosphoric and Molybdovanadophosphoric Acids	196
J. L. G. FIERRO, J. M. D. TASCÓN, AND L. GONZÁLEZ TEJUCA. Physicochemical Properties of LaMnO ₃ : Reducibility and Kinetics of O ₂ Adsorption	209
WM. CURTIS CONNER AND ALAN M. LANE. Measurement of the Morphology of High Surface Area Solids: Effect of Network Structure on the Simulation of Porosimetry	217
N.-S. CHIU, S. H. BAUER, AND MARVIN F. L. JOHNSON. Co/Mo/Al ₂ O ₃ Catalyst Structure Determination by EXAFS. I. Mo K Edge in the Oxidized State	226
D. C. JOHNSTON, A. J. JACOBSON, B. G. SILBERNAGEL, S. P. FRYSSINGER, S. M. RICH, AND L. A. GEBHARD. Magnetic Susceptibility and Electron Spin Resonance as Probes of Different Magnetic Species in MoS ₃	244
C. J. CASEWIT AND A. K. RAPPÉ. Theoretical Characterization of deNO _x Catalysis: The Initial Nitrogen Coupling Step	250
R. A. CABROL AND A. OBERLIN. Nature and Localization of Poisoning Carbonaceous Matter in Reforming Catalyst Studied by Transmission Electron Microscopy	256
WARREN W. KAEDING, L. BREWSTER YOUNG, AND CHIN-CHIUN CHU. Shape-Selective Reactions with Zeolite Catalysts. IV. Alkylation of Toluene with Ethylene to Produce <i>p</i> -Ethyltoluene	267
G. MURALIDHAR, BERNARDO E. CONCHA, GREG L. BARTHOLOMEW, AND CALVIN H. BARTHOLOMEW. Characterization of Reduced and Sulfided, Supported Molybdenum Catalysts by O ₂ Chemisorption, X-Ray Diffraction, and ESCA	274
L. M. TAU AND C. O. BENNETT. Kinetic and Mössbauer Study of the CO/H ₂ Reaction over Fe/TiO ₂ Reduced at Various Temperatures	285
TERRENCE J. UDOVIC AND J. A. DUMESIC. Preparation and Characterization of Magnetite Surfaces on Metallic Iron Substrates	303
TERRENCE J. UDOVIC AND J. A. DUMESIC. Adsorptive Properties of Magnetite Surfaces as Studied by Temperature-Programmed Desorption: Studies of O ₂ , NO, CO ₂ , and CO Adsorption	314
L. M. TAU AND C. O. BENNETT. Reaction Intermediates on Fe/TiO ₂ during CO/H ₂ Reaction	327

LEO E. MAKOVSKY, JOHN M. STENCEL, FRED R. BROWN, RICHARD E. TISCHER, AND SIDNEY S. POLLACK. A Surface Spectroscopic Study of Co-Mo/Al ₂ O ₃ Catalysts Using ESCA, ISS, XRD, and Raman Spectroscopy, 1.....	334
DAVID J. KAUL AND EDUARDO E. WOLF. FTIR Studies of Surface Reaction Dynamics. I. Temperature and Concentration Programming during CO Oxidation on Pt/SiO ₂	348
J. N. NUDEL, B. S. UMANSKY, R. O. PIAGENTINI, AND E. A. LOMBARDO. Selective Hydrogenation of 1,3-Butadiene over LaCoO ₃ Perovskite.....	362
SAYRA R. ADKINS AND BURTRON H. DAVIS. The Chemical State of Tin in Platinum-Tin-Alumina Catalysts	371
KEITH B. KESTER AND JOHN L. FALCONER. CO Methanation on Low-Weight Loading Ni/Al ₂ O ₃ : Multiple Reaction Sites.....	380
MARY McLAUGHLIN McCLORY AND RICHARD D. GONZALEZ. The Role of Alkali Metals as Promoters in the Methanation and Fischer-Tropsch Reaction: An <i>in Situ</i> Study.....	392
J. M. HERRMANN. Electronic Effects in Strong Metal-Support Interactions on Titanium Deposited Metal Catalysts	404
MAMORU AI. Oxidation of Methyl Ethyl Ketone to Diacetyl on V ₂ O ₅ -P ₂ O ₅ Catalysts	413
R. T. K. BAKER, E. B. PRESTRIDGE, AND G. B. McVICKER. The Interaction of Palladium with Alumina and Titanium Oxide Supports	422
SHIRLEY S. CHAN AND ALEXIS T. BELL. Characterization of the Preparation of Pd/SiO ₂ and Pd/La ₂ O ₃ by Laser Raman Spectroscopy	433
B. H. BARTLEY AND P. H. EMMETT. Catalytic Cracking of <i>n</i> -Hexadecane. VI. Carbon-14 Tracer Studies of Secondary Reactions over Amorphous Silica-Alumina and Zeolite Catalysts	442
TADASHI KAWAI, YASUO YAMAZAKI, TADAYOSHI TAOKA, AND KAZUHIRO KOBAYASHI. Metathesis of α,ω -Dienes over a CsNO ₃ -Re ₂ O ₇ -Al ₂ O ₃ Catalyst in Liquid Phase.....	452
A. N. MANSOUR, J. W. COOK, JR., D. E. SAYERS, R. J. EMRICH, AND J. R. KATZER. Determination of Support and Reduction Effects for Pt/Al ₂ O ₃ and Pt/SiO ₂ by X-Ray Absorption Spectroscopy	462
I. V. ELEV, B. N. SHELIMOV, AND V. B. KAZANSKY. The Role of Ni ⁺ Ions in the Activity of NiCaY Zeolite Catalysts for Ethylene Dimerization.....	470
R. CID, F. J. GIL LLAMBIAS, J. L. G. FIERRO, A. LÓPEZ AGUDO, AND J. VILLASEÑOR. Physicochemical Characterization of MoO ₃ -NaY Zeolite Catalysts....	478
S. ANANTHAN, N. VENKATASUBRAMANIAN, AND C. N. PILLAI. Reaction of Benzaldehyde with Other Carbonyl Compounds over Thoria and Mixed Oxides of Thoria: Development of an Effective Catalyst and a Process for the Conversion of Benzaldehyde to Phenyl Alkyl Ketones	489
ROBERT F. HICKS, QI-JIE YEN, AND ALEXIS T. BELL. Effects of Metal-Support Interactions on the Chemisorption of H ₂ and CO on Pd/SiO ₂ and Pd/La ₂ O ₃ ...	498
SHIGERU TSURUYA, TORU TAKAKI, AND MITSUO MASAI. The Oxidative Coupling of 2,6-Dimethylphenol Catalyzed by Basic Copper(II) Complexes.....	511
R. M. DESSAU. Shape-Selective Platinum/ZSM-5 Catalysts	520

NOTES

M. PATRICIA SUÁREZ, JORGE O. CECINI, AND DANIEL G. LÖFFLER. Interactions of Methane with Tungsten, Molybdenum, and Platinum	527
N. HOMS, P. RAMÍREZ DE LA PISCINA, AND J. E. SUEIRAS. Modification of the Surface Acidity of γ -Alumina.....	531

L. M. TAU, D. BIANCHI, C. O. BENNETT. The Chemisorption of CO on Fe/ Al ₂ O ₃	533
BERNARDO E. CONCHA, GREG L. BARTHOLOMEW, AND CALVIN H. BARTHOLO- MEW. CO Hydrogenation on Supported Molybdenum Catalysts: Effects of Support on Specific Activities of Reduced and Sulfided Catalysts.....	536
W. A. A. VAN BARNEVELD AND V. PONEC. On the Apparent Controversy Regarding the Effect of Alloying on the Selectivity of the Fischer-Tropsch Synthesis	542
P. L. GAI. Electron Microscopy of β -Bismuth Molybdate	545
J. H. ONUFERKO, S. J. DECANIO, C. DYBOWSKI, I. W. HALL, AND B. C. GATES. Migration of Supported Metals during Preparation for Electron Microscopy	550
C. F. NG AND C. K. CHAN. Infrared Study of Dehydrochlorination of <i>tert</i> -Butyl Chloride on First-Row Transition Metal Chlorides	553
M. JAYAMANI, B. VISWANATHAN, AND C. N. PILLAI. Preparation, Characteri- zation, and Comparison of Properties of Alumina Catalysts	560

ERRATUM

Volume 84, Number 1, November 1983: M. Otarod, S. Ozawa, F. Yin, M. Chew, H. Y. Cheh, and J. Happel, "Multiple Isotope Tracing of Methana- tion over Nickel Catalyst. III. Completion of ¹³ C and D Tracing," pp. 156- 169	564
--	-----

AUTHOR INDEX FOR VOLUME 89.....	565
---------------------------------	-----

The Subject Index for Volume 89 will appear in the December 1984 issue as part of a cumulative index for the year 1984.

INFORMATION FOR AUTHORS

The *Journal of Catalysis* publishes articles dealing with original studies in heterogeneous and homogeneous catalysis as well as studies relating catalytic properties with chemical processes at surfaces, studies of chemistry of surfaces, and engineering studies related to catalysis. All articles will be published in English.

Submission of Manuscripts. Manuscripts should be sent by registered mail to either of the Editors:

Professor W. Keith Hall
Department of Chemistry
University of Wisconsin
Milwaukee, Wisconsin 53201

Professor Frank S. Stone
School of Chemistry
University of Bath
Bath BA2 7AY, England

Original papers only will be considered. Manuscripts are accepted for review with the understanding that the same work has not been and will not be nor is presently submitted elsewhere, and that its submission for publication has been approved by all of the authors and by the institution where the work was carried out; further, that any person cited as a source of personal communications has approved such citation. Written authorization may be required at the Editor's discretion. Articles and any other material published in the *Journal of Catalysis* represent the opinions of the author(s) and should not be construed to reflect the opinions of the Editor(s) and the Publisher.

Authors submitting a manuscript do so on the understanding that if it is accepted for publication, copyright in the article, including the right to reproduce the article in all forms and media, shall be assigned exclusively to the Publisher. The Publisher will not refuse any reasonable request by the author for permission to reproduce any of his or her contributions to the journal.

Form of Manuscript. Manuscripts should be concise and consistent in style, spelling, and use of abbreviations. Submit manuscript (in English) in triplicate, including the original typewritten copy, with copies of all figures and tables. All material (including tables, reference lists, etc.) should be typed double-spaced on one side of 8.5 × 11-in. white bond paper (with 1-in. margins on all sides). Each page of the manuscript should be numbered. *Page 1* should contain the article title, authors' names (without degrees), affiliations, a running title (abbreviated form of title) not exceeding 45 letters and spaces, and an address to which proof should be mailed. *Page 2* should contain a short abstract.

Authors should use descriptive headings in this order: Abstract, Introduction, Methods, Results, Discussion, Acknowledgments, and References.

In the Methods section, authors should draw attention to any particular chemical or biological hazards that may be involved in carrying out the experiments described. Any relevant safety precautions should be described; if an accepted code of practice has been followed, a reference to the relevant standards should be given.

Notes and Letters to the Editor may not exceed 8 double-spaced typewritten manuscript pages (including tables and figures). Accepted *Notes* will not receive publication priority over articles.

Letters to the Editor will be considered for priority publication under the following conditions: (a) Letters must be related to some statement made in a recently published article in this Journal; (b) in cases of conflicting views on any topic, no more than one Letter from each author will be accepted.

Units of weights, measures, etc., when used in conjunction with numerals should be abbreviated and unpunctuated (e.g., 10%, 50 ml, 3 g, 8 cm).

The SI (Système International) system of units will be accepted without editorial change. Authors using other units are encouraged to define them in terms of SI units once in each publication, e.g., in an article where pressures are quoted in Torr to write "1 Torr = 133.3 N m⁻²." For information concerning SI units, see *Manual of Symbols and Terminology for Physicochemical Quantities and Units*, prepared by M. L. McGlashan and published by Butterworth, London, 1969.

Footnotes should be avoided if possible; but if essential, they should be designated by superscript Arabic numerals (starting with title) in the text.

Tables should be numbered with Arabic numerals in order of mention in the text. They should be typed double-spaced on separate pages. Each table should have a short descriptive caption typed (double-spaced) above the table. Table footnotes (indicated by superscript, lowercase, italic letters) should be typed at the end of the table.

Figures should be numbered with Arabic numerals in order of mention in the text; each figure should have a descriptive legend. Legends should be typed double-spaced together on a separate page. All illustrations should be in finished form suitable for photoreproduction. No figures should exceed 8.5 × 11 in. (21 × 27.5 cm). Drawings should be made with India ink on tracing linen, good quality tracing paper, smooth surface white paper, or Bristol board. Graph paper if used should be ruled in blue. Grid lines that are to show in the final reproduction should be inked in black.

Copies of drawings are not acceptable unless they are high contrast glossy prints. All but the very simplest structures and structural formulas must be designed for direct reproduction. Lettering should be large enough to be legible after a reduction of 50–60%. Illustrations in color can be accepted only if the authors defray the cost.

References to the literature should be cited in the text by italic Arabic numerals in parentheses, set on the text line, and listed numerically at the end of the paper. Abbreviations of journal titles should follow the style used in *Chemical Abstracts Service Source Index*, 1980. Style and punctuation of references should be in accordance with the following examples:

1. McVicker, G. B., Kramer, G. M., and Ziemiak, J. J., *J. Catal.* **83**, 286 (1983).
2. Klier, K., in "Advances in Catalysis" (D. D. Eley, H. Pines, and P. B. Weisz, Eds.), Vol. 31, p. 243. Academic Press, New York, 1982.
3. Pines, H., "The Chemistry of Catalytic Hydrocarbon Conversions." Academic Press, New York, 1981.

Proofs. Proofs will be sent to the author, with a reprint order form. Authors will be charged for alterations in excess of 10% of the cost of composition.

Reprints. Fifty reprints without covers will be provided free of charge. Additional reprints may be purchased; an order form will be included with proofs.

